MPEG IPR Ontologies for Media Trading and Personalization

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ABSTRACT

The Media Value Chain Ontology (MVCO, ISO/IEC 21000-19) facilitates rights tracking for fair and transparent royalties payment by capturing user roles and their permissible actions on a particular intellectual property (IP) asset. However, widespread adoption of interactive music services (remixing, karaoke and collaborative music creation) - thanks to Interactive Music Application Format (ISO/IEC 23000-12) - raises the issue of rights monitoring when reuse of audio IP entities is involved, such as, tracks or even segments of them in new derivative works.

The Audio Value Chain Ontology (AVCO, ISO/IEC 21000-19/AMD1) addresses this issue by extending MVCO functionality related to description of composite IP entities in the audio domain, whereby the components of a given IP entity can be located in time, and for the case of multi-track audio, associated with specific tracks. The introduction of an additional 'reuse' action enables querying and granting permissions for the reuse of existing IP entities in order to create new derivative composite IP entities.

Furthermore, smart contracts for media assets are likely to be required to facilitate the lightweight trading and usage of those assets by facilitating machine readable deontic expressions for permissions, obligations and prohibitions, with respect to particular users and IP entities. The security of these transactions may be used in conjunction with distributed ledgers, e.g., blockchain, enabling both transparency and interoperability towards fair trade of audio and video assets.

While the main focus of this paper is in the music domain and the description of the recently published AVCO standard, related developments (e.g., standards, formats and smart contracts) in the media domain are also discussed from the media trading and personalization point of view.

CCS CONCEPTS

• Personalization • Electronic Data Interchange • Media Arts

KEYWORDS

Smart Contracts; Value Chain; Semantics; Commercial media; Object-Based Media; Blockchain

1. INTRODUCTION

Copyright legislation has continuously evolved with the aim to revive the music industry, in terms of fair and increased revenues returned to artists and rights holders, improved multi-territory licensing, timely payments, and overall more transparency, e.g., US Music Modernization Act [1] and EU Copyright Directive Reform [2]. Meanwhile, several key artists and musicians have turned their hopes for resolving these issues to technology and in particular, towards blockchain.

Blockchain emerged in 2008 as the technology that underpins bitcoin. It operates as a shared ledger, which continuously records transactions or information. Its database structure, where there is a timestamp on each entry and information linking it to previous blocks, makes it not only transparent but exceptionally difficult to tamper with.

Initiatives investigating blockchain have been launched around the world. In the US, Open Music Initiative (OMI) [3] has been launched by Berklee Institute for Creative Entrepreneurship, harnessing the MIT Media Lab's expertise in decentralized platforms, whose mission is: to promote and advance the development of open source standards and innovation related to music, to help assure proper compensation for all creators, performers and rights holders of music. It should be noted that OMI focus, understandably, on (i) new works rather than the vast legacy music catalogue, with the aim that the same principles can be applied to legacy music retrospectively; and, (ii) on achieving interoperability among infrastructures, databases and systems so to be accessed, shared and exchanged by all stakeholders.

In Europe, one of blockchain's evangelists is the Grammy award-winning UK singer, songwriter and producer Imogen Heap. She has launched a blockchain project, Mycelia [4]. Although still in its foundational stages, she intends it to be an entire ecosystem that utilizes blockchain as a way to enact a complete shake up in the music industry. Mycelia's mission is to: (i) empower a fair, sustainable and vibrant music industry ecosystem involving all online music interaction services; (ii) unlock the huge potential for creators and their music related metadata so an entirely new commercial marketplace may flourish; (iii) ensure all involved are paid and acknowledged fully; (iv) set commercial, ethical and technical standards in order to exponentially increase innovation for the music services of the future; and (v) connect the dots with all those involved in this shift from our current outdated music industry models, exploring new technological solutions to enliven and positively impact the music ecosystem.

However, whilst enthusiasm is growing for blockchain, it is likely to be several years before we see it rolled out in a wide-scale, mainstream capacity. Blockchain enables value to be transferred over the Internet. For contractual media (or other) asset trading smart contracts can be used to encode the terms and conditions of a contract (business logic) [5]. They validate contractual agreements between stakeholders before a blockchain value transfer is enabled [6]. In other words, smart contracts, implemented via software, could allow audio and video royalties to be administered almost instantaneously and manage usage allowances and restrictions. Rather than passing through intermediaries, revenue from a stream or download could be distributed automatically between rights holders, according to agreed terms and conditions (e.g., splits), as soon as an asset is downloaded or streamed [7].

While the main focus of this paper is in the music domain and the description of the recently published AVCO standard (Section 3, 4, 5, 6), related developments (e.g., standards, formats and smart contracts) in the television domain are also discussed (Section 2) from the media trading and personalization point of view (Section 7).

2. STANDARDS AND FORMATS FOR DATA DRIVEN PERSONALIZATION

For data driven personalization the main approach is to consider the selection and usage tracking of audio and video objects for placement into an existing scene or presentation. This section gives a brief overview of the components needed for such a music and media trading ecosystem, based on MPEG standards:

- **Content identification** is a fundamental component of any asset trade system. An asset identifier can be random so long as it can also be discovered by alternate IDs such as the International Standard Recording Code (ISRC) or the International Standard Work Code (ISWC) or other internal fields or keywords. These alternate IDs enable two or more organizations to discover and share a common identifier for an asset.

  The MPEG-21 Digital Item Identification [9] provides a simple, extensible and interoperable mechanism on how to integrate in music trade systems not only existing but even future alternate identification schemes by facilitating the elements: (i) *Identifier*; and (ii) *RelatedIdentifier*.

- **ISO Base Media File Format (ISO BMFF)** [9] is currently the most widely adopted multimedia file structure standard (.mp4 extension) facilitating storage, interchange, management and editing. ISO BMFF derived MPEG-A: Interactive Music Application Format (IM AF) [10] (aka STEMS [11]) specifies how to combine multiple audio tracks with additional information, e.g., dynamic volume changes for DJ mixing and lyrics for karaoke applications.

  For example, with IM AF various tracks can be remixed by users enabling them to share their remixes in social networks. Recipient users of the media can develop a reputation through music citations, similar to that of scientific citations [12]. Similar developments could take place in video e.g. user overlays.

- **Dynamic Adaptive Streaming over HTTP (DASH)** [13] is an adaptive bitrate streaming technique, universally deployed, that allows smart TVs and mobile phones to consume high quality multimedia content, while seamlessly adapt to variable network conditions.

Following the example of IM AF, DASH streaming enables radio producers and DJs to schedule playlists for streaming to their radio stations and clubs, respectively, and perform live mixing. In this case, artists could even be notified when their assets are scheduled for streaming, thus, enabling artists/fans interaction.

- **Media Contract Ontology (MCO)** [14] facilitates the conversion of narrative contracts to digital ones. It consists of a core model, which provides the elements for the creation of generic deontic statements encompassing the concepts of permission, prohibition and obligation, and two extensions:
    - Exploitation of Intellectual Property Rights, e.g., licensing for broadcasting or public performance;
    - Payments and Notifications, e.g., royalties' splits between rights holders and currency conversions.

- **Media Value Chain Ontology (MVCO)** [15, 16, 17] is capable of representing in a machine processable way, the life cycle (aka value chain) of Intellectual Property (IP) entities. The relationship between a user and a particular IP entity type (e.g., work, adaptation, product, copy) is specified through the concept of role. The actions that a user takes on a given IP entity determine the role of that user with respect to the IP entity in question. Users get roles (e.g., creator, adaptor, producer, end-user) that attribute them rights over actions (e.g., create work, make adaptation, produce, distribute, synchronise) that can be exercised on specific IP entities. Any given user may take on any number of roles within a given value chain. These relations are shown in Figure 1.

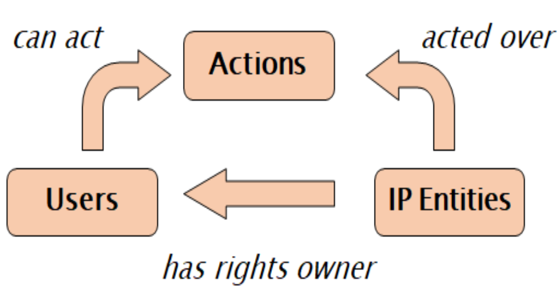

Figure 1: Relations between Actions, Users and IP Entities.

Thus, MVCO facilitates rights tracking for fair and transparent royalties' payment by capturing user roles and their permissible actions on a particular IP entity. Furthermore, it enables music navigation based on IP rights through their visualization as co-author graphs revealing collaborations and influences among artists.

- **Audio Value Chain Ontology (AVCO)** [18, 19] facilitates transparent IP rights management even when content reuse is involved. In particular widespread adoption of interactive music services (remixing, karaoke and collaborative music creation) - thanks to IM AF/STEMS - raises the issue of rights monitoring when reuse of audio IP entities is involved, such as, tracks or even segments of them in new derivative works.

The Audio Value Chain Ontology addresses this issue by extending MVCO functionality related to description of composite IP entities in the audio domain, whereby the components of a given IP entity can be located in time, and for the case of multi-track audio, associated with specific tracks. The introduction of an additional 'reuse' action enables querying and granting permissions for the reuse of existing IP entities in order to create new derivative composite IP entities.

- **Monetization** could be done either with legacy digital rights management systems or using blockchain.

MPEG-M digital media services ecosystem is described in [20]. In our context, of particular interest is the fact that MPEG-M facilitates easy creation of new services by combining service components (aka engines), such as the aforementioned ones, as well as, innovative business models because of the ease to design and implement interoperable media-handling value chains since they are all based on the same set of technologies, especially MPEG technologies. An MPEG-M architecture adapted for enabling interactive music applications with IP rights tracking, based on the aforementioned components, is shown in Figure 2.

Figure 2. MPEG-M architecture adapted for enabling interactive music applications and services with IP rights tracking.

3. ISSUING BODY AND SCHEDULE

Taking into consideration the music industry and artists needs for interoperable smart contracts enabling 'music rights transparency' and after collection of requirements and sufficient support in terms of resources from a number of National Bodies, ISO/IEC MPEG Requirements Group decided to approve the embarkation of the development of both:

(i) the specification on Multimedia Framework (MPEG-21) - Part 19: Media Value Chain Ontology (MVCO) / Amendment 1: Extensions on Time-Segments and Multi-Track Audio (ISO/IEC 21000-19:2010/AMD1:2018) [18]; and,
(ii) its associated reference software on Multimedia Framework (MPEG-21) - Part 8: Reference Software / Amendment 4: Media Value Chain Ontology Extensions on Time-Segments and Multi-Track Audio (ISO/IEC 21000-8:2008/AMD4:2018) [19].

After approval by the Requirements Group, the development of the aforementioned amendments, which are collectively also known as Audio Value Chain Ontology (AVCO) was carried out under the auspices of the ISO/IEC MPEG Systems Group. The AVCO requirements have been published in June 2015, while the AVCO specification and its associated reference software, after completing successfully all ballot stages, e.g., Preliminary Draft Amendment (PDAM), Draft Amendment (DAM) and Final Draft Amendment (FDAM), published as ISO/IEC international standards, in June and October 2018, respectively.

4. AUDIO VALUE CHAIN ONTOLOGY

The MVCO is intended to handle asset IP entities of different domains, such as music, still image, video and text. Although it provides the means for the description of composite IP entities, this functionality is limited to simply stating which IP entities are part of another IP entity, without specifying them further, e.g., in time. However, there are many cases where a more detailed description of IP components becomes necessary for the accurate tracking of contributions and rights of a composite IP entity, including in the audio domain, with DJ mixes, podcasts, music samples in compositions, and multi-track audio becoming increasingly popular.

Thus, the AVCO constitutes an extension of MVCO and in particular of its functionality related to the description of composite IP entities in the audio domain, whereby the components of a given IP entity can be located in time and, for the case of multi-track audio, associated with specific tracks. The motivation is to facilitate rights management of audio IP entities, in particular when reuse of audio IP entities is involved.

Furthermore, in the audio domain there are several examples, where a work is created by reusing existing IP entities. For instance, DJ mixes consist of a sequence of recordings, where songs can be mixed together during transitions. In modern music production, especially in electronic dance music it is commonplace that parts of other recordings are reused - also known as sampling. Ideally, a rights management system shall be capable of locating these components within such a composite IP entity.

Multi-track audio resources can have audio material on different tracks that are derived from individual IP entities with different rights holders. In order to identify the media value chain in these cases, it is necessary the individual tracks and their associated metadata to be able to be represented in a consistent way.

The concept of time segments and tracks for the location of IP entities is illustrated in Figure 3.

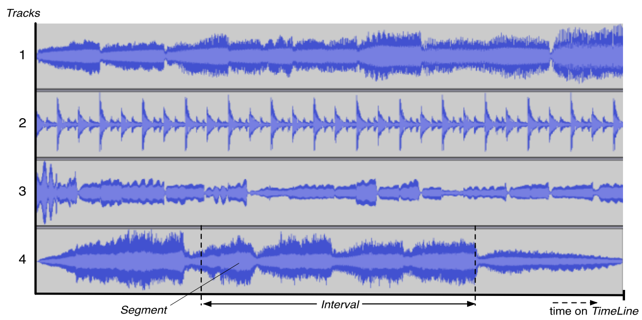

Figure 3. Visualized multi-track audio. Segment are within an interval on a TimeLine. Segments can exist on specified tracks.

Widespread adoption of multi-track formats such as the MPEG-A: Interactive Music Application Format (ISO/IEC 23000-12) raises the issue of rights monitoring for fair and transparent royalties payment with respect to reusable tracks or even segments of them in derivative new works. The AVCO for IP entities in the audio domain addresses this issue by facilitating complex matrix-based rights monitoring on time vs tracks throughout the media value chain. It defines concepts for the representation of time segments and tracks of multi-track audio IP entities. Segments and tracks may contain IP entities that can be treated as conventional IP entities as defined in MVCO. The introduction of an additional action 'ReuseIPEntity' in MVCO enables granting permissions for the reuse of existing IP entities in order to create new derivative composite IP entities.

5. DESCRIPTION OF RELATIONS FOR IP ENTITY SEGMENTS AND TRACKS

The relations for the representation of composite IP Entities in the audio domain that reuse other existing IP Entities are illustrated in Figure 4. The reused IP Entities may exist on specified Segments and, in the case of multi-track IP Entities, on specified Tracks. An IP Entity (object) has a certain Segment. A Segment is in a part-of relationship with the IP Entity linked with the hasSegment property, and its class is subsumed by IPEntity. The Segment, in turn, 'contain' another IP Entity, which represents one of the components the composite IP Entity is made up of. Since we are dealing with IP Entities in the audio domain, we can associate a timeline with it. The property interval links an IP Entity to an Interval.

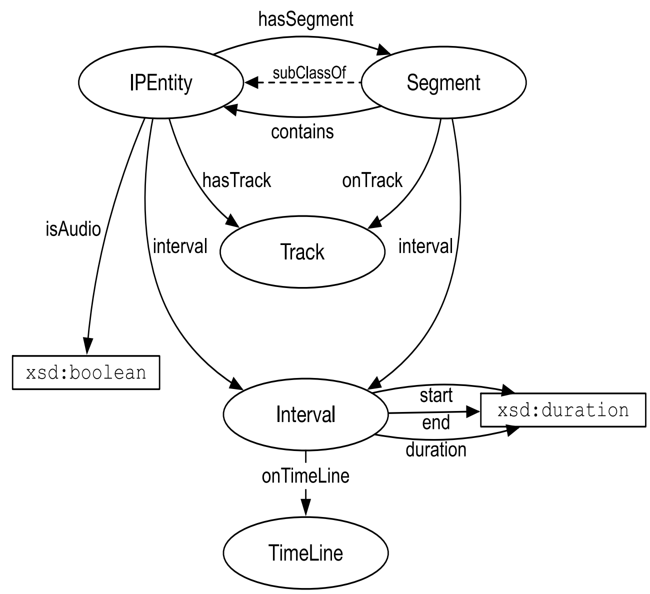

Figure 4. Classes and relationships for the representation of IP Entities that contain other existing IP Entities. *Segments* can also be associated with individual Tracks of a multi-track audio IP Entity.

An Interval is defined, similarly to Intervals in the Time Ontology in OWL[1], as a temporal entity with extent. The duration of the audio resource is specified with the duration property linking to an explicit datatype. The property onTimeLine relates the Interval with a timeline. In order to express that the Segment exists within a certain Interval on the same timeline, in a similar fashion an Interval is related to the Segment using the interval property. The beginning and end of an Interval are specified through an explicit datatype using the properties start and end, respectively. The interval is related to the timeline with the onTimeLine property. Since Segment is a subclass of IPEntity, it is also possible to associate the Segment with its own timeline. The timeline class is based on the timeline model of the Timeline Ontology[2].

For the case of multi-track resources, an IP Entity is related to Tracks with the hasTrack property. To express that a Segment exists on a certain Track, it is linked to the respective Track using the onTrack property.

[1] https://www.w3.org/TR/owl - time/
[2] http://motools.sourceforge.net/timeline/timeline.179.html

5.1 Usage Example for Audio Segments

Consider a podcast, for instance a program made available in digital format that consists of several music pieces. A podcast may be defined as a single IP Entity. However, the podcast consists of a number of media items such as songs with individual property rights, which are played successively.

In this example, with respect to Figure 5, the podcast is represented by the Manifestation *Bobmanifestation*. Bob is the creator of the respective Work (not shown), hence it is stated that the rights owner of the podcast is the user *Bob*. It is stated that, within the time interval of 122.1 s to 324.3 s, a Manifestation of Alice's Work is part of the program. For Bob to acquire the appropriate permission for this action, Alice issues the permission (*License1*) for Bob to reuse her IP Entity (*ActionTemplate1*). In order to represent the time information, an Interval (*Interval1)* spanning the duration of the podcast is associated with *BobManifestation* using the duration property. *Interval1* is related to a timeline (*BobTimeLine)* with the onTimeLine property. The individual *BobSegment* represents the segment of *BobManifestation* in which *AliceManifestation* is present: *BobSegment* 'has' the segment *BobSegment*, while *BobSegment* 'contains' *AliceManifestation*. The segment is associated with an Interval (*Interval2*) which is characterized by a start and end point specified with the data properties start and end. To express that this segment exists on the same timeline as the podcast (*BobManifestation*), the property hasTimeLine links *Interval2* with *BobTimeLine*.

5.2 Usage Example for Multi-Track Audio

Consider a music resource that is distributed in a multi-track format. The individual tracks (or segments on those tracks) have different media value chains. For instance, with respect to Figure 6, the user *Bob* may create a 4 minutes long music piece (*BobManifestation2*), which uses a vocal recording by *Alice* (*AliceManifestation2*) on a separate Track within a 210 s interval starting at 10 s. Expressing this with the ACVO is done in a similar fashion as in the podcast example described in the previous section. However, the additional information with regards to tracks is expressed by first stating that *BobManifestation2* 'has' the Track *BobTrack1*. The Track individual is also specified by an integer identifier '1' using the property trackNumber. Then, the segment containing *AliceManifestation2* is associated with *BobTrack1* using the property onTrack.

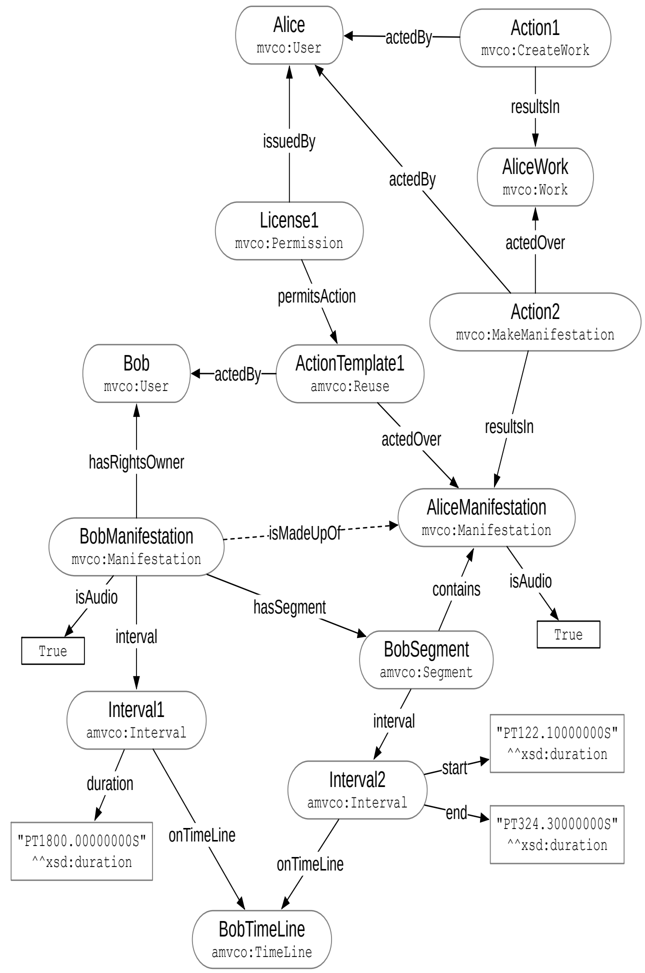

Figure 5. Description of a Segment of an audio IP Entity containing an existing IP Entity.

Specifying tracks and segments that contain IP Entities enables the user to:

- answer queries about the components of composite IP Entities;
- answer queries about which kind of Role a User plays with respect to a certain IP Entity of a particular track or time segment;
- answer queries about provenance, rights and permissions concerning individual parts of a composite IP Entity, covering the complete media value chain.

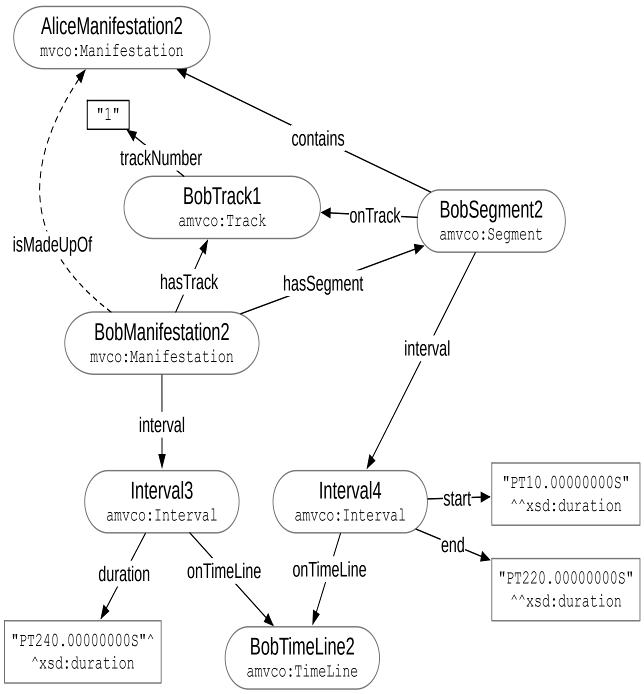

Figure 6. Description of a Segment of a multi-track audio IP Entity containing an existing IP Entity.

6. SOFTWARE GUIDELINES

The Reference Software for MVCO [16] has been updated to support its Extensions on Time-Segments and Multi-Track Audio [19]. It should be noted that only the ontologies MVCO and AVCO are normative while the interfaces written in Java are optional. The latter allows application developers and system integrators to develop their own interfaces in the programming language of their preference matching their development environment and application.

The following use case illustrates composite IP Entities that are made up of other IP Entities on segments and tracks. These IP Entities have different rights holders that are members of collectives.

Consider a Work, that is made up of a composition associated with a Guitar score and another with the lyrics of the song. The rights holder of the complete Work (*MusicWork*) is a Collective (*Composers*) that has as its members the rights holders (*ComposerGuitar* and *ComposerLyrics*) of the individual works for the guitar composition (*GuitarWork*) and the lyrics (*LyricsWork*). The steps required for this Work registration are shown in Table 1 alongside the corresponding Java commands.

Table 1. Steps required for a Work registration including its Composer (score) and Lyricist (lyrics).

Steps	Java commands
Register user *ComposerGuitar*	java -jar rvdac.jar -r -cu ComposerGuitar
Register user *ComposerLyrics*	java -jar rvdac.jar -r -cu ComposerLyrics
Register user collective *Composers*	java -jar rvdac.jar -r -cc Composers
Connect users to *Composers*	java -jar rvdac.jar -r -ac ComposerGuitar Composers java -jar rvdac.jar -r -ac ComposerLyrics Composers
Make *ComposerGuitar* create the work *GuitarWork*	java -jar rvdac.jar -r -cip ComposerGuitar CreateWork none GuitarWork
Make *ComposerLyrics* create the work *LyricsWork*	java -jar rvdac.jar -r -cip ComposerLyrics CreateWork none LyricsWork
Make *Composers* create the Work *MusicWork*	java -jar rvdac.jar -r -cip Composers CreateWork none MusicWork
Link individual Works to *MusicWork*	java -jar rvdac.jar -r -lc MusicWork GuitarWork java -jar rvdac.jar -r -lc MusicWork LyricsWork

The composition is performed by two musicians, a guitarist (*Guitarist*) and a singer (*Vocalist*), who belong to a collective of performers (*Performers*). The performance constitutes a Manifestation (*MusicManifestation*), that is made up of two individual manifestations, one for the guitar (*GuitarManifestation*) and one for the vocals (*LyricsManifestaion*). In order to make the manifestations three permissions are created. The collective of composers gives a permission to the collective of performers, while the individual composers give permissions to the respective performers. The steps required for this Manifestation registration are shown in Table 2 alongside the corresponding Java commands.

Table 2. Steps required for a Manifestation registration including two Performers (Guitarist and Vocalist).

Steps	Java commands
Register user *Guitarist*	java -jar rvdac.jar -r -cu Guitarist
Register user *Vocalist*	java -jar rvdac.jar -r -cu Vocalist
Register user collective *Performers*	java -jar rvdac.jar -r -cc Performers
Connect users to *Performers*	java -jar rvdac.jar -r -ac Guitarist Performers java -jar rvdac.jar -r -ac Vocalist Performers
Create separate permissions *MakeManifestation* for *Guitarist*, *Vocalist* and *Performers*	java -jar rvdac.jar -r -cp Composers MakeManifestation MusicWork Performers java -jar rvdac.jar -r -cp ComposerGuitar MakeManifestation GuitarWork Guitarist java -jar rvdac.jar -r -cp ComposerLyrics MakeManifestation LyricsWork Vocalist
Make *Manifestations*	java -jar rvdac.jar -r -cip Performers MakeManifestation MusicWork MusicManifestation java -jar rvdac.jar -r -cip Guitarist MakeManifestation GuitarWork GuitarManifestation java -jar rvdac.jar -r -cip Vocalist MakeManifestation LyricsWork LyricsManifestation
Link individual Manifestations to *MusicManifestation*	java -jar rvdac.jar -r -lc MusicManifestation GuitarManifestation java -jar rvdac.jar -r -lc MusicManifestation LyricsManifestation

A recording of the performance is described as an Instance (*MusicInstance*). In this example we assume the rights holders of the Instance to be the performers that made the Manifestations. Three Instances are made. The collective Performers makes *MusicInstance*, which is an Instance of *MusicManifestation*. Guitarist makes *GuitarInstance*, which is an Instance of *GuitarManifestation*. Vocalist makes *LyricsInstance*, which is an Instance of *LyricsManifestation*. The Java commands required for the registration of these Instances are shown in Table 3.

Table 3. Instances (recordings) registration including two Performers (Guitarist and Vocalist) assuming they are the same who made the Manifestations (live performance).

Step	Java commands
Make *Instances*	java -jar rvdac.jar -r -cip Performers MakeInstance MusicManifestation MusicInstance java -jar rvdac.jar -r -cip Guitarist MakeInstance GuitarManifestation GuitarInstance java -jar rvdac.jar -r -cip Vocalist MakeInstance LyricsManifestation LyricsInstance

On the instance level the tracks and segments are described. The recording consists of two tracks, one for the guitar and one for the vocals. The guitar track spans the whole recording, while the vocal track is specified by an interval starting at 30s and ending 150s. The individual performers give the collective *Performers* the permission to 'reuse' the individual Instances to be combined in *MusicInstance*. The steps required for combining tracks and segments in an Instance are shown on Table 4 alongside the corresponding Java commands.

Table 4. Steps required for combining tracks and segments in an Instance.

Steps	Java commands
Set the media domain of *MusicInstance* to audio	java -jar rvdac.jar -r -sda MusicInstance true
Create *descriptions* for the two tracks of *MusicInstance*, with identifiers *1* and *2*	java -jar rvdac.jar -r -ct MusicInstance 1 java -jar rvdac.jar -r -ct MusicInstance 2
Members of the collective *Performers* give rights for reuse to the collective	java -jar rvdac.jar -r -cp Guitarist Reuse GuitarInstance Performers java -jar rvdac.jar -r -cp Vocalist Reuse LyricsInstance Performers
Performers put *GuitarInstance* on track 1	java -jar rvdac.jar -r -cs MusicInstance GuitarInstance none none 1
Performers put *LyricsInstance* on track 1, within an interval specified by start and end times	java -jar rvdac.jar -r -cs MusicInstance LyricsInstance 30 150 2

Using additional commands, it is now possible to query the database for information about user collectives and the components of the composite IP Entities.

List members of a user collective:

```
$ java -jar rvdac.jar -r -lcu Composers
Administration Console
ComposerGuitar
ComposerLyrics

$ java -jar rvdac.jar -r -lcu Performers
Administration Console
Guitarist
Vocalist
```

List components of a composite IP Entity (including tracks and segments where applicable):

```
$ java -jar rvdac.jar -r -lic MusicWork
Administration Console
LyricsWork
GuitarWork

$ java -jar rvdac.jar -r -lic MusicManifestation
Administration Console
LyricsManifestation
GuitarManifestation

$ java -jar rvdac.jar -r -lic MusicInstance
Administration Console
LyricsInstance | segment: 30s to 150s | track: 2
GuitarInstance | track: 1
```

The aforementioned use case may be relatively simple, however, complex use cases, e.g., rights workflow on Baby Boy song by Beyoncé ft. Sean Paul as described in [3], could similarly be built upon using MVCO/AVCO smart contracts which in turn could be executed on blockchain.

7. DATA FOR THE VALUE CHAIN PERSONALIZATION

For media personalization (including standard broadcast platforms) a likely scenario is for audio and video assets to be sought and acquired from third party libraries and traded into the recipient video for distribution and playback to the viewer. The data infrastructure behind has been presented as a B2B platform [21].

For future TV commercial services we consider assets which are likely to be:

- A final production full length video programme
- A full length audio programme (and likely the sound track to a video programme)
- One of a range of audio or video clips which form part of video programme version, for example one of different language tracks, a clip of a different version of a programme (for example in an IMF delivery container), etc.
- An audio object as part of an object based presentation or programme
- A video object as part of an object based presentation or programme

Having established the AVCO technology for audio assets to be reused, the application can be considered for personalization of video where assets of interest to end viewers are selected and integrated into a media work. We also need to consider the cases where finished media works are delivered to an end user who may utilize an element of that program, for example, an extract of the soundtrack, an interview, a specific object, etc. Such items are the intellectual property or copyright of the original author, performer, etc. and need to be recorded and made available for contractual use. Such assets may have restrictions and stipulations for further usage. For example, the copyright owner of a soundtrack may want to restrict its usage in future works to avoid association undesired social or political affiliations.

Further to this, a media market environment can be envisaged where assets are sought and integrated into feature works on a rapid basis. This requires an instant responsive contractual environment. Smart contracts are seen as such a lightweight scheme to allow just-in-time media edits for personalized usage.

Object-based media [22] also allows end-users to interact with the object components of the media work and consequently such objects may carry interaction restrictions. Again, such usage allowances need to be recorded and instantaneously operable to permit or disallow interactions as required by the object copyright owner, the copyright owner of the overall work, or any combination of copyright holders for the work.

Consequently we see a media value chain with a suitable semantic access as afforded by the MVCO and, as described above, the AVCO as an extension. We now see the need for contractual processes to utilize these standards but at "atomized" object level, and hence the need for smart contract procedures secured on a suitable platform, currently envisaged to be blockchain-based. However it should also be considered that the link between the contract layer and the blockchain layer should be kept open, like an API interface. This allows a loose-coupling and a flexibility between the two layers, so the contract process may be performed on other security layers, and to interwork with non-blockchain platforms (as most traditional media trading platforms will be for some time yet).

Object based Interactive Personalized TV services are presented as a proposed platform in [23]. The various types of data management are subject to increasing scrutiny for ethics and moral applications. This is particularly so for profile management where end user data is needed to increase the success of a personalized placement into a video, and especially for advertising purposes [24, 25, 26].

8. CONCLUSIONS

The AVCO extension to the MVCO and its application for reusable music assets has been described. With increasing reuse of object based audio and video assets for advanced services including personalization, there is increasing need to identify and manage the usage of assets, and to provide for a lightweight contracting mechanism to allow their trading and usage, possibly in near-real-time. Contracts based on MVCO/AVCO have been introduced in this paper which has described their ability to facilitate machine readable deontic expressions for permissions, obligations and prohibitions, with respect to particular users and IP entities. Further, their support on a distributed ledger platform, e.g., blockchain, enables transparency and interoperability towards fair trade of media assets. This secure asset trading and management platform will provide a solid base for commercial data-driven media personalization services.

REFERENCES

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